

Appl. No. 09/977,069
Amdt. dated September 11, 2003
Reply to Office Action of June 11, 2003

PATENT

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

Claims 1-5. (canceled)

Claim 6. (previously presented) A semiconductor device comprising:

(a) a substrate;

(b) a diffusion barrier, wherein the diffusion barrier comprises a self-assembled monolayer including a plurality of molecules, each molecule having an aromatic group at the terminus of the molecule; and

(c) a metal layer comprising copper on the diffusion barrier, wherein for each molecule in the plurality of molecules, the copper in the metal layer is in direct contact with the aromatic group of the molecule.

Claim 7. (previously presented) The semiconductor device of claim 6 wherein the substrate comprises silicon oxide on silicon.

Claim 8. (previously presented) The semiconductor device of claim 6 wherein each molecule comprises a linear carbon chain having at least 2 carbon atoms.

Claim 9. (previously presented) The semiconductor device of claim 6 wherein the metal layer is formed by a vapor deposition process.

Claim 10. (previously presented) The semiconductor device of claim 6 wherein the diffusion barrier is capable of preventing the diffusion of copper atoms from the metal layer into the substrate when the semiconductor device is exposed to thermal annealing at 200 °C or an electric field of 2 MV/cm at 200 °C in flowing N₂.

Appl. No. 09/977,069
Amdt. dated September 11, 2003
Reply to Office Action of June 11, 2003

PATENT

Claim 11. (previously presented) The semiconductor device of claim 6 wherein the diffusion barrier coats the walls of a hole in the substrate and wherein the metal layer fills the hole.

Claim 12. (canceled).

Claim 13. (previously presented) A semiconductor device comprising:

- (a) a semiconductor substrate;
- (b) a diffusion barrier, wherein the diffusion barrier comprises a self-assembled monolayer including a plurality of molecules, each molecule having a linear chain at least two atoms long, and an aromatic group at the terminus of the molecule; and
- (c) a metal layer comprising copper on the diffusion barrier, wherein the metal layer is formed by a vapor deposition process, and wherein the copper in the metal layer is in direct contact with the aromatic group of each molecule in the self-assembled monolayer.

Claim 14. (previously presented) The semiconductor device of claim 13 wherein the substrate comprises silicon oxide on silicon.

Claim 15. (previously presented) The semiconductor device of claim 13 wherein each molecule comprises a linear carbon chain having at least 2 carbon atoms.

Claim 16. (previously presented) The semiconductor device of claim 13 wherein the metal layer is formed by a sputtering process.

Claim 17. (previously presented) The semiconductor device of claim 13 wherein the diffusion barrier is capable of preventing the diffusion of copper atoms from the metal layer into the substrate when the semiconductor device is exposed to thermal annealing at 200 °C or an electric field of 2 MV/cm at 200 °C in flowing N₂.

Appl. No. 09/977,069
Amdt. dated September 11, 2003
Reply to Office Action of June 11, 2003

PATENT

Claim 18. (previously presented) The semiconductor device of claim 13 wherein the substrate comprises silicon oxide on silicon.

C
end
Claim 19. (previously presented) The semiconductor device of claim 13 wherein the device does not exhibit $j_{\text{leakage}} > 1000 \text{ nAcm}^{-2}$ when the semiconductor device is exposed to thermal annealing at 200 °C or an electric field of 2 MV/cm in flowing N₂ at 200 °C for up to 650 minutes.

Claim 20 cancelled.
